MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2016/2017

ECP3086 – MULTIMEDIA TECHNOLOGY AND APPLICATIONS

(RE and BE)

13 OCTOBER 2016
2.30 p.m - 4.30 p.m
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This question paper consists of 6 pages excluding cover page with 4 questions only.

2. Answer **ALL** questions. All questions carry equal marks and the distribution of the marks for each question is given.

3. Please write all your answers in the answer Booklet provided.

Question 1

(a) Identify the 3 (THREE) main important technologies that contribute to the advancement of multimedia applications. Justify with details. [6 marks]

(b) Construct the HTML codes as **Figure 1.1** below: (image: coffee.jpg)

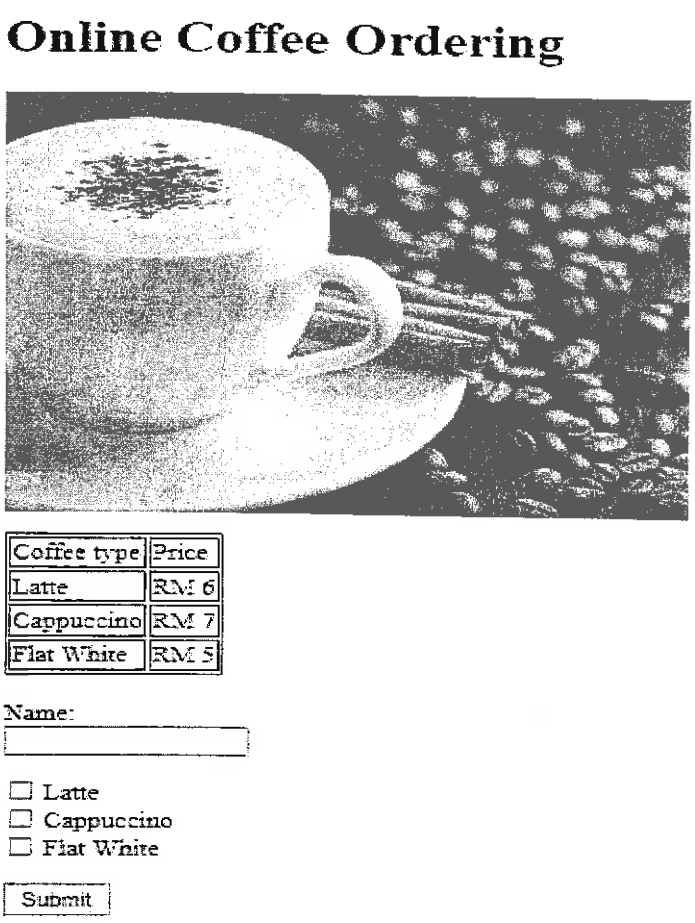

Figure 1.1 [10 marks]

(c) Use LZW algorithm to encode the string "wahahawahahawahahaha".

(i) Compute the encoder output code after compression. Use Table 1 as reference. [7 marks]

(ii) Compute the compression ratio by assuming that 8 bit fixed-length code is used before compression and after compression. [2 marks]

Continued .....

Table 1

Current symbol S	Next symbol C	Encoder output	S+C string	Dictionary a – 1 h – 2 w – 3 symbol code

Question 2

(a) Subtractive color mixing is based on reflective colors rather than emissive colors. In order to print blue colour from CMYK colour scheme, determine which colours should be substracted. [3 marks]

Hint: $\begin{bmatrix} C \\ M \\ Y \end{bmatrix} = \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix} - \begin{bmatrix} R \\ G \\ B \end{bmatrix}$

(b) In JPEG image compression, the DCT coefficients are quantized first before sending it for run length coding. The DCT coefficients matrix for an 8 x 8 image block is given in Figure 2.1. The luminance and chrominance quantization table is given in Figure 2.2 and Figure 2.3 respectively. Based on the given information, answer the following questions.

$$q_c(i,j) = round\left(\frac{q(i,j)}{C(i,j)}\right)$$

round(x) *will round the number to the nearest integer.*

-415	-30	-61	27	56	-20	-2	0
5	-22	-61	10	13	-7	-8	5
-47	7	77	-24	-29	10	5	-6
-49	12	34	-15	-10	6	2	2
12	-7	-13	-4	-2	2	-3	3
-8	3	2	-6	-3	1	4	2
-1	0	0	-3	-1	-3	4	-1
0	0	-1	-4	-1	0	0	2

Figure 2.1 : DCT Coefficients Matrix *q(i,j)*

Continued .....

Question 2

16	11	10	16	24	40	51	61
12	12	14	19	26	58	60	55
14	13	16	24	40	57	69	56
14	17	22	29	51	87	80	62
18	22	37	56	68	109	103	77
24	35	55	64	81	104	113	92
49	64	78	87	103	121	120	101
72	92	95	98	112	100	103	99

Figure 2.2 : Luminance Quantization Matrix *C(i,j)*

17	18	24	47	99	99	99	99
18	21	26	66	99	99	99	99
24	26	56	99	99	99	99	99
47	66	99	99	99	99	99	99
99	99	99	99	99	99	99	99
99	99	99	99	99	99	99	99
99	99	99	99	99	99	99	99
99	99	99	99	99	99	99	99

Figure 2.3 : Chrominance Quantization Matrix *C(i,j)*

Q2(b)

(i) Find the quantized DCT coefficient matrix $q_c(i, j)$ for luminance and chrominance respectively. [3+2 marks]

(ii) Draw the direction of zig-zag scanning. [3 marks]

(iii) Obtain the output of the Run-Length Coding (RLC) for the AC coefficient for both luminance and chrominance after zig-zag scanning. Use the format (Run length, Value) for your run length code. [3+2 marks]

(iv) Justify your answer obtained in (iii) for luminance and chrominance by referring to the human visual system. [3 marks]

(c) A geometric operation changes the image size, shape and orientation of the input image. It maps pixel information in an input image to another location in an output image. Name 3 (THREE) geometric transformation operations. [3 marks]

Continued .....

(d) Determine the value of center pixel after mean filtering with window size 3×3 in **Figure 2.4** below. [3 marks]

156	187	178
144	166	190
195	156	140

Figure 2.4

Question 3

(a) An analog signal can be digitized with pulse code modulation (PCM) method. The quality of the encoded signal depends mainly on two encoding parameters. Describe the two parameters and how it affects the quality of the encoded signal. [6 marks]

(b)

(i) Define signal-to-quantization-noise ratio (SQNR). [2 marks]

(ii) If 8-bit linear quantization is used, calculate the largest quantization error if the signal is in the range between -10V to 10V. [4 marks]

(c) A differential PCM (DPCM) is used to encode an audio signal based on the following prediction and quantization formula.

$$\hat{f}_n = \text{fix}\left(\tfrac{1}{2}\left(\tilde{f}_{n-1} + \tilde{f}_{n-2}\right)\right)$$

$$\tilde{e}_n = Q\left[e_n\right] = 16 \times \text{fix}\left(\tfrac{1}{16}\left(255 + e_n\right)\right) - 256 + 8$$

fix (x) will round x to the lower integer number

A signal f_n and its initialized value is given in the following table 3. Based on the given information, compute predicted signal value $\hat{f}_n$, prediction error e_n, the quantized error $\tilde{e}_n$ and the reconstructed signal $\tilde{f}_n$ for n= 2,3 , 4 and 5. [8 marks]

Continued .....

Table 3

Sample number	n	0	1	2	3	4	5
Signal value	f_n	120	120	100	130	170	200
Predicted signal value	$\hat{f}_n$	120	120				
Prediction error	e_n	0	0				
Quantized prediction error	$\tilde{e}_n$	0	0				
Reconstructed signal value	$\tilde{f}_n$	120	120				

(d) Determine the specified DPCM in question 3(c) a lossy or lossless compression. Justify your answer based on your previous calculation. [2 marks]

(e) A CDDA (Compact Disc Digital Audio) has sampling rate of 44.1 kHz. According to Nyquist criterion, this frequency is sufficient to produce a good quality of sound for human hearing. Justify your answer. [3 marks]

Question 4

(a) A drama episode with 4CIF video resolution (704 × 576) that display true color is played with frame rate of 25 fps. Assume that the average video drama length of 45mins and without any compression.

(i) Determine the number of drama episodes that can be loaded in a hard disk of 1TB capacity. [4 marks]

(ii) Propose 2 methods in order to load more drama episodes in the 1TB hard disk and justify the effects of each method proposed. [4 marks]

(b) MPEG-4 is the video coding standard used in 3G video call functions. In compressing the video sequence for 3G video call, I-frame and P-frame are used but B-frame is not used although MPEG-4 supports the usage of B-frame. Justify why B-frame is not used in 3G video call. [3 marks]

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(c) Discuss 3 (THREE) differences between IPTV and Internet video. [6 marks]

(d) A content based image retrieval system using query by example is to be evaluated. The query image is shown in Figure 4.1 and the tamura texture feature vector of the query image is given by f^Q = [0.2 0.3 0.7 0.8 0.8 0.3]

Figure 4.1: Query image

Table 4.1 shows the image database consisting of five images and its corresponding tamura texture feature vector. Based on Euclidian distance, find the two most similar images to the query image. Show all steps and calculations performed in the retrieval process.

Table 4.1

i	Image	Tamura texture feature vector f^D_i
1.jpg		[0.3 0.4 0.8 0.8 0.7 0.5]
2.jpg		[0.2 0.4 0.7 0.8 0.7 0.3]
3.jpg		[0.5 0.3 0.4 0.5 0.8 0.5]
4.jpg		[0.3 0.4 0.7 0.6 0.8 0.4]
5.jpg		[0.5 0.5 0.6 0.6 0.6 0.7]

[8 marks]

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